MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2018/2019

DTC5088 – ANALOG AND DIGITAL COMMUNICATION SYSTEMS

(Diploma in Electronic Engineering)

11 MARCH 2019
9.00 a.m. – 11.00 a.m.
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of **4** pages excluding the cover page and appendixes.
2. Answer **ALL** questions. All questions carry equal marks and the distribution of the marks for each question is given.
3. Please write all your answers in the answer booklet provided.

QUESTION 1 [25 MARKS]

a) Sketch the block diagram for the communication system and explain the function for each of the component. [8 marks]

b) Explain **FOUR (4)** classes of the signals [8 marks]

c) For the given signal $x(t)$ in Figure 1, answer the following:

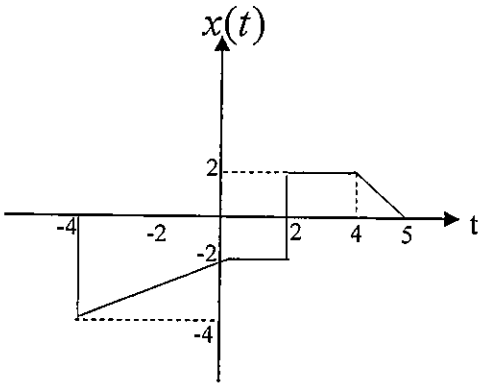

Figure 1

i) Find and sketch the signal operation output for $x\left(\frac{3t+1}{4}\right)$ and $x\left(\frac{-t}{2}\right)$. Solve the outputs separately. [8 marks]

ii) State the types of the signal operation involved in (i) [1 mark]

Continued...

QUESTION 2 [25 MARKS]

a) Define the modulation process and sketch the simple block diagram for the modulation process. [4 marks]

b) Briefly describe the detector section of the FM receiver. [6 marks]

c) Explain the **THREE (3)** types of behavior modulation in the Amplitude Modulation with aid of diagram. [6 marks]

d) A sinusoidal audio signal is being modulated by using Amplitude Modulation to an index of 80% and producing $s(t) = 40 \cos (2\pi \times 200000t) + 40 \cos (2\pi \times 120000t)$

i) Determine the bandwidth, BW. [2 marks]

ii) Construct a frequency spectrum for the modulated signal by assuming the signal is a multi-tone signal. [2 marks]

iii) Calculate the amplitude of modulating signal, A_m and amplitude of carrier signal, A_c. [5 marks]

Continued...

QUESTION 3 [25 MARKS]

a) Describe **TWO (2)** types of modulations in the Pulse Time Modulation (PTM) systems. [4 marks]

b) Explain the **THREE (3)** advantages and **ONE (1)** disadvantage of PCM system. [4 marks]

c) Describe the process involved in a Pulse Code Modulation (PCM) Transmitter with the aid of diagrams. [4 marks]

d) An input signal with the maximum frequency of 30 kHz is to be received in a digital device by using Pulse Code Modulation (PCM) technique. The input signal is sampled at Nyquist rate and a sample encoded with 8 bits only. Determine the following:

i) The number of level that used in quantization. [2 marks]

ii) Bit rate of the PCM signals. [2 marks]

e) Given a transmission medium used ranges from 2 kHz to 12 kHz. If the transmission is in 8-PSK half-duplex mode, calculate the following:

i) Bandwidth [2 marks]

ii) Baud rate [1 mark]

iii) Bit rate [2 marks]

f) Describe the **FOUR (4)** advantages of QAM compared to the ASK and FSK. [4 marks]

Continued...

QUESTION 4 [25 MARKS]

a) Briefly describe **ONE (1)** major problem in Unipolar Encoding. [2 marks]

b) Explain the Bipolar Encoding. State **ALL** types of bipolar encoding that are used by the data communication industry. [4 marks]

c) Figure 2 is the Differential Manchester encoding of a data stream. Construct the data stream. [2 marks]

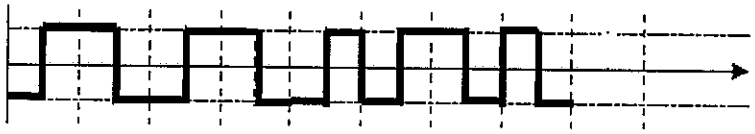

Figure 2

d) Figure 3 is the Bipolar Alternate Mark Inversion encoding of a data stream. Construct the data stream. [2 marks]

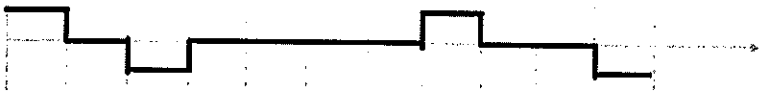

Figure 3

e) Describe single bit error. Suggest one error correction mechanism to solve this problem and why? [3 marks]

f) Explain the redundancy concept for the error detection mechanism in the transmission. [3 marks]

g) Construct the Hamming Code before the transmitter transmits the bit sequence of 100110110 to the receiver. [9 marks]

End of Page.

APPENDIX

(A) Amplitude Modulation

Carrier signal, $s_c(t) = A_c \cos(\omega_c t)$

Modulating signal, $s_m(t) = A_m \cos(\omega_m t)$

Amplitude-modulated signal,

DSB-LC: $s(t) = A_c \cos\omega_c t + \frac{A_m}{2}\cos(\omega_c - \omega_m)t + \frac{A_m}{2}\cos(\omega_c + \omega_m)t$

DSB-SC: $s(t) = \frac{A_m A_c}{2}\cos(\omega_c + \omega_m)t + \frac{A_m A_c}{2}\cos(\omega_c - \omega_m)t$

SSB-SC:

LSB : $s_{LSB}(t) = \frac{A_m A_c}{2}\cos(\omega_c t - \omega_m t)$

USB : $s_{USB}(t) = \frac{A_m A_c}{2}\cos(\omega_c t + \omega_m t)$

(B) Frequency Modulation

$$\begin{aligned}\phi_{FM} = {} & A_c J_0(m_f)\sin\omega_c t + \\ & A_c\left(J_1(m_f)(\sin(\omega_c + \omega_m)t - \sin(\omega_c - \omega_m)t)\right) + \\ & A_c\left(J_2(m_f)(\sin(\omega_c + 2\omega_m)t - \sin(\omega_c - 2\omega_m)t)\right) + \\ & A_c\left(J_3(m_f)(\sin(\omega_c + 3\omega_m)t - \sin(\omega_c - 3\omega_m)t)\right) + \\ & A_c\left(J_4(m_f)(\sin(\omega_c + 4\omega_m)t - \sin(\omega_c - 4\omega_m)t)\right) + \\ & A_c\left(J_5(m_f)(\sin(\omega_c + 5\omega_m)t - \sin(\omega_c - 5\omega_m)t)\right) + \ldots + \\ & A_c\left(J_n(m_f)(\sin(\omega_c + n\omega_m)t - \sin(\omega_c - n\omega_m)t)\right)\end{aligned}$$

Bessel table function

Modulation Index (m_f)	Carrier Frequency J_0	n or order of sidebands J_1	J_2	J_3	J_4	J_5	J_6	J_7	J_8	J_9	J_{10}	J_{11}	J_{12}	J_{13}	J_{14}	J_{15}	J_{16}
0.00	1.00	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
0.25	0.98	0.12	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
0.5	0.94	0.24	0.03	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1.0	0.77	0.44	0.11	0.02	—	—	—	—	—	—	—	—	—	—	—	—	—
1.5	0.51	0.56	0.23	0.06	0.01	—	—	—	—	—	—	—	—	—	—	—	—
2.0	0.22	0.58	0.35	0.13	0.03	—	—	—	—	—	—	—	—	—	—	—	—
2.5	−0.05	0.50	0.45	0.22	0.07	0.02	—	—	—	—	—	—	—	—	—	—	—
3.0	−0.26	0.34	0.49	0.31	0.13	0.04	0.01	—	—	—	—	—	—	—	—	—	—
4.0	−0.40	−0.07	0.36	0.43	0.28	0.13	0.05	0.02	—	—	—	—	—	—	—	—	—
5.0	−0.18	−0.33	0.05	0.36	0.39	0.26	0.13	0.05	0.02	—	—	—	—	—	—	—	—
6.0	0.15	−0.28	−0.24	0.11	0.36	0.36	0.25	0.13	0.06	0.02	—	—	—	—	—	—	—
7.0	0.30	0.00	−0.30	−0.17	0.16	0.35	0.34	0.23	0.13	0.06	0.02	—	—	—	—	—	—
8.0	0.17	0.23	−0.11	−0.29	−0.10	0.19	0.34	0.32	0.22	0.13	0.06	0.03	—	—	—	—	—
9.0	−0.09	0.24	0.14	−0.18	−0.27	−0.06	0.20	0.33	0.30	0.21	0.12	0.06	0.03	0.01	—	—	—
10.0	−0.25	0.04	0.25	0.06	−0.22	−0.23	−0.01	0.22	0.31	0.29	0.20	0.12	0.06	0.03	0.01	—	—
12.0	0.05	−0.22	−0.08	0.20	0.18	−0.07	−0.24	−0.17	0.05	0.23	0.30	0.27	0.20	0.12	0.07	0.03	0.01
15.0	−0.01	0.21	0.04	−0.19	−0.12	0.13	0.21	0.03	−0.17	−0.22	−0.09	0.10	0.24	0.28	0.25	0.18	0.12

Source: E. Cambi, *Bessel Functions,* Dover Publications, Inc., New York, N.Y., 1948. Courtesy of the publisher.

(C) AM Superheterodyne Receiver

Local oscillator frequency,

$$f_{LO} = f_{RF(C)} + f_{IF(C)}$$

$$f_{LO} = f_{RF(USF)} + f_{IF(LSF)}$$

$$f_{LO} = f_{RF(LSF)} + f_{IF(USF)}$$